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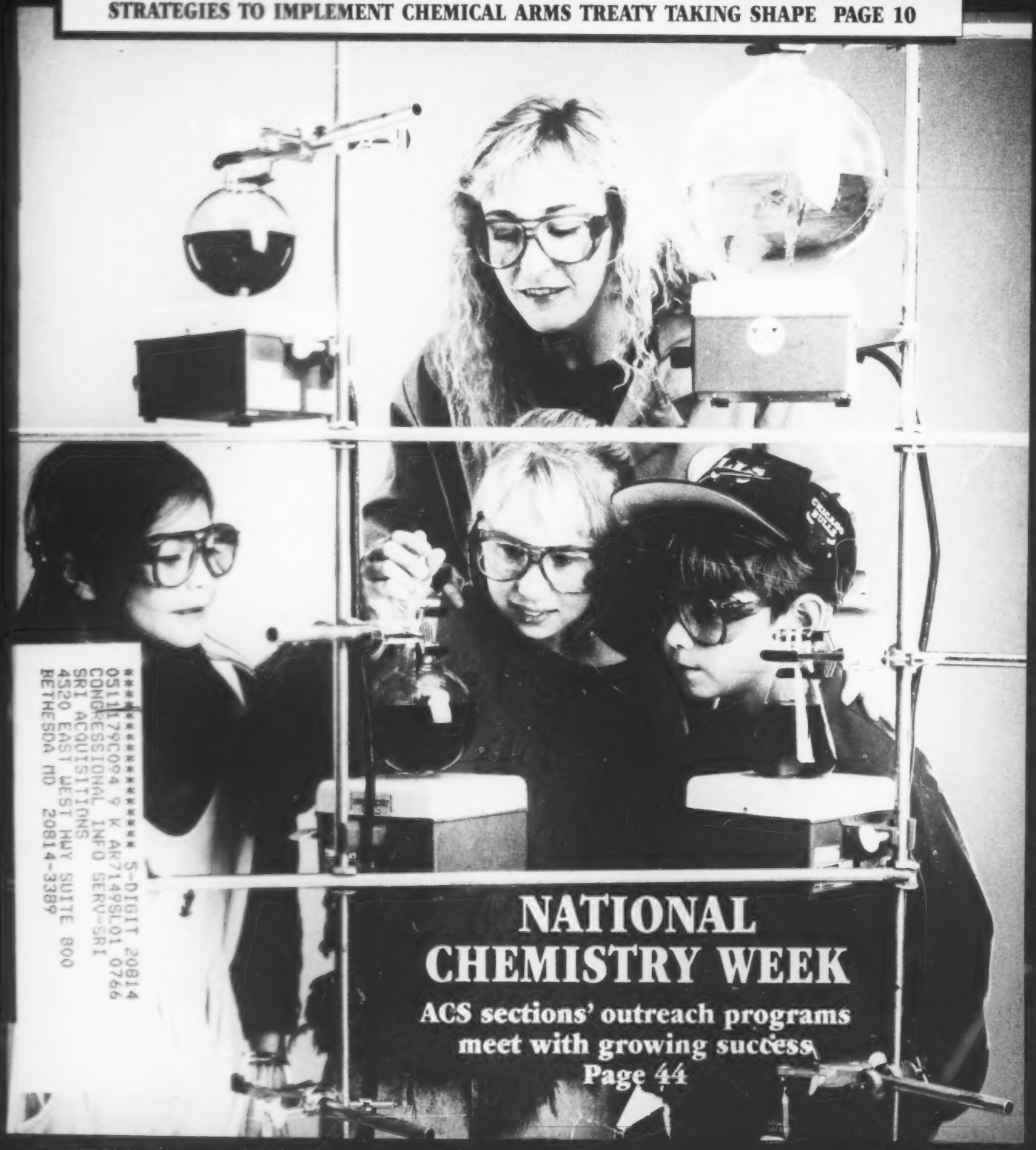
CHEMICAL & ENGINEERING NEWS

C&EN

DECEMBER 6, 1993

STRATEGIES TO IMPLEMENT CHEMICAL ARMS TREATY TAKING SHAPE PAGE 10



NATIONAL CHEMISTRY WEEK

ACS sections' outreach programs meet with growing success

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CHEMICAL & ENGINEERING NEWS

C&EN

DECEMBER 6, 1993

NEWS OF THE WEEK

■ Federal programs for science, engineering, and technology education lack coordination, evaluation, and accountability, according to an expert panel's report. Page 6

■ Steadily dropping crude oil prices—and the recent plunge—may bring little benefit to petrochemical producers. Page 7

■ High-temperature superconducting conductor that carries more than twice the amperage of conventional underground conductors has been produced by American Superconductor. Page 7

■ Two new zeolites with structures that could permit more highly controlled catalysis are synthesized with organic structure-directing agents. Page 8

■ Vietnam vets petition the Supreme Court for permission to sue makers of agent orange. Page 8

■ Genetic engineering techniques, one developed in Italy and another in the U.S., make plants more resistant to disease. Page 9

COVER: Students from Lincoln Elementary in Kingsport, Tenn., observe dyes in different solvents as part of Northeast Tennessee Section's National Chemistry Week program. Photo courtesy of Eastman Chemical

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NEWS FOCUS

Executive secretary of the Preparatory Commission, chemical engineer Ian R. Kenyon, discusses strategies for implementing the landmark chemical weapons treaty. Page 10

BUSINESS

Pharmaceutical firms are adding internal biotechnology units as avenues for growth in response to changes in health care system and rising competition from smaller firms. Page 25

GOVERNMENT

Whether to phase out chlorine and chlorinated organics was debated again by speakers from government, industry, and environmental groups at a meeting in Canada. Page 31

SCIENCE/TECHNOLOGY

Planning grants for projects aimed at speeding access to chemical information through electronic technology have been made to eight universities and two colleges. Page 40

Mechanism for incorporating carbon monoxide catalytically into organic compounds carbonylates a diacetylene and then adds carbon monoxide. Page 40

Japanese chemists asymmetrically synthesize enantiomeric phosphine ligands, chiral at phosphorus, and use them to make asymmetric reaction catalysts. Page 41

MEETINGS

PITTCON '94—45th Pittsburgh Conference—miniprogram includes listing of technical sessions together with registration, housing, and other information. Page 60

ACS NEWS

The energy and enthusiasm of all 186 local sections made this year's National Chemistry Week the most successful ever. Page 44

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LETTERS

Other effects of EMFs

Your recent news focus on electromagnetic fields by Bette Hileman (C&EN, Nov. 8, page 15) provided extensive coverage on many facets of the controversy regarding health effects of EMFs, but omitted the aspect that is probably of greatest interest to the majority of your readers—effects on chemical reaction rates.

The stimulation of DNA transcription rates, first described by Goodman and Henderson, has been demonstrated in several labs over the past decade, and the resulting changes in protein biosynthesis offer a plausible link to the health effects that were the focus of the article. Other studies have now shown that the changes in protein synthesis caused by electromagnetic fields are similar to the stress response found in all cells, another biologically relevant link to disease. Our own research on changes in the rate of ATP-splitting by the Na,K-ATPase provides another example of an important biochemical reaction that is affected by low-level fields. These and many other studies on the subject appear in the Proceedings of the First World Congress entitled "Electricity and Magnetism in Biology and Medicine," (M. Blank, Editor, San Francisco Press, 1993). For those interested in the latest developments on all aspects of the issue, I strongly recommend that this volume be added to the suggested reading list.

Martin Blank
Department of Physiology
& Cellular Biophysics
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I have read with considerable interest the article, "Health Effects of Electromagnetic Fields Remain Unresolved" by Bette Hileman. Unfortunately, neither Hileman nor the individuals she quotes saw fit to present the whole story on biological and health effects of electromagnetic fields. I certainly agree with many of the points in the article, particularly those that indicate that there are bioresponses to certain types of fields and that the hazards remain moot.

The missing part of her presentation concerns the beneficial health effects of selected pulsed electromagnetic fields (PEMFs). Time-varying magnetic fields designed to induce electric fields in tissue similar to those resulting naturally from deformation (for example, strain) during physical activity are used around the world daily to treat various human disease states. PEMFs were approved as safe and effective by the Food & Drug Administration in 1979 for treating chronically unhealed fractures. Since then, upward of 300,000 such cases have been treated with no known risk, no need for surgery, and at a cost of one third to one half of hospitalization for an operation. Healing rates and times are similar to those of bone grafting. The office method is broadly accepted and applied by orthopedic surgeons, more than 17,000 of whom have prescribed PEMFs since FDA's approval.

Many of the biological and cellular effects of PEMFs that are responsible for the healing of ununited fractures have been delineated. In fact, at the biomechanism level, as much is known as for the pharmacologic actions of aspirin. More recently, a variety of other pathologic processes have been proven amenable to control or improvement with selected PEMFs. These include osteonecrosis in young adults (commonly called a "heart attack" of the hip); osteoporosis; osteoarthritis; chronic refractory tendinitis of the shoulder; and brittle bone disease (osteogenesis imperfecta). In each of these, the biological effects of PEMFs appear to address specific features of the underlying pathology.

Cardiac and cerebral ischemia (that is, heart attack and stroke) also have been reported in the past two years to benefit from early use of PEMFs in animal studies. Although the biomechanisms of action in these two conditions are not yet defined, possible effects on nitric oxide and oxygen radicals (for example, via superoxide dismutase) seem to be prime targets for study.

During the course of basic science studies on PEMFs, a number of biological and physical principles have emerged on specificity. These indicate that lumping time-varying magnetic fields into a common pattern of bioeffects is not only incorrect, but stunts progress toward a broader understanding of both potential hazards and new benefits. In the biohazard arena, epidemiologic and laboratory studies that assume that 50- or 60-Hz sine fields are the "culprit" may be far off base, if data from the benefit arena have any validity. Until spectral analysis of line voltage alterations by power surges, switching transients, and a host of other sources of field pattern modifications are incorporated into "hazard" research, the complexities of biosignaling probably will continue to wallow in a sea of confounders.

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SCIENCE EDUCATION

Federal programs lack coordination

Federally funded education programs in science, mathematics, engineering, and technology are "burdened by a lack of coordination, a lack of evaluation, and a lack of accountability," says a report released last week by a panel of experts.

The federal investment in science education needs a stronger management plan to provide balance and coherence across federal agencies, the panel concludes. Existing programs need to be evaluated consistently and rigorously, then modified, dropped, or expanded in light of the results of the evaluations.

The 15-member Expert Panel for the Review of Federal Education Programs in Science, Mathematics, Engineering & Technology was appointed in January 1993 by the education committee of the Federal Coordinating Council for Science, Engineering & Technology (FCCSET). The National Science Foundation (NSF), one of the 16 federal agencies making up FCCSET, directed and supported the panel's work.

The panel identified nearly 300 education programs budgeted at almost $2.2 billion for fiscal 1993. It did not study each program exhaustively, but looked at the scope of the federal effort as a whole, and the extent to which it has been evaluated. "This is the first time federal programs have been examined as a whole under independent scrutiny," says panel cochairman Karl S. Pister, chancellor of the University of California, Santa Cruz.

"Much of the reform called for 10 years ago in the National Commission on Excellence in Education's landmark report, 'A Nation at Risk,' remains unfinished," Pister notes. "The federal effort is not sufficiently coordinated to reverse the mediocrity that exists. The programs need to be managed as a portfolio of investments." That will require a new culture of interaction among and within federal agencies, he adds.

Panel cochairman Mary Budd Rowe, professor of science education at Stanford University, points out that only one in five programs has been evaluated. One of the panel's key recommendations is that programs be evaluated rigorously to judge how effective they are in meeting identified goals. "We can't afford to be investing big amounts in programs that don't work," she stresses. "We need to be supporting those that do."

C&EN staff photo

Williams: sustained evaluation needed

Luther S. Williams, NSF's assistant director for education and human resources and acting chairman of the FCCSET education committee, acknowledges that there has not been a sustained, comprehensive evaluation effort among federal agencies. "We have a backlog, a cumulative debt for not having done it in the past," he says.

Even before the expert panel completed its report, FCCSET's education committee developed a comprehensive plan that sets a five-year schedule for evaluating all the federal programs, Williams notes. The new report validates that plan and will be valuable in getting Congress and agencies to commit the necessary resources, he adds. Currently only about 1% of the total science, mathematics, engineering, and technology education budget is set aside for evaluation; Rowe estimates that about 10% ought to be.

The panel makes three other major recommendations. It advises investing in learning what works. "The federal government is in a unique position to pro-

1993 budget targeted $2.2 billion for science education

$ Millions	Total	K–12	Undergraduate	Graduate	Public understanding of science
NSF	$ 537.9	$309.8	$143.1	$ 79.1	$ 5.9
Defense	526.7	24.8	140.1	361.8	0
Health & Human Services	464.1	26.9	33.4	401.9	1.9
Education	340.9	328.3	12.6	0	0
Energy	102.1	27.4	52.1	17.5	5.1
Interior	86.0	23.1	7.9	10.8	44.2
NASA	79.8	20.5	24.8	34.5	0
Agriculture	24.4	1.2	13.7	9.5	0
Smithsonian	10.1	0.7	0.1	0.5	8.8
EPA	9.0	7.1	0.9	1.0	0
Commerce	5.2	0	0	5.2	0
TOTAL	$2,186.2	$769.8	$428.7	$921.8	$65.9

Source: "The Federal Investment in Science, Mathematics, Engineering, and Technology Education: Where Now? What Next? Sourcebook," August 1993, National Science Foundation.

vide leadership in educational research to determine what works in particular educational settings," Rowe says.

The federal government also should market its investments, according to the panel. "All of us on the committee discovered all sorts of programs that we simply didn't know about," Rowe notes. "People aren't finding out about the good stuff that's going on."

The panel also recommends investing in the future by providing aid for teacher training at all education levels. "In the view of the panel, some of the worst teaching going on is at the university level," Rowe says. She points out that chemistry courses have the highest dropout rate of all college-level courses.

Pamela Zurer

Oil price drop may not benefit petrochemicals

After slipping steadily over the past summer, crude oil prices plunged more than $1.00 per barrel early last week—falling to $15.30 a barrel for January delivery of West Texas intermediate crude, for example, the lowest level in five years. The world oil market was moving aggressively to punish the Organization of Petroleum Exporting Countries for refusing to cut production.

Ironically, this drop in oil prices may bring little benefit to petrochemical producers, even though crude oil is a key raw material for making a spectrum of basic olefins and aromatic chemicals: makers of plastics and other downstream goods are demanding discounts on petrochemicals almost as quickly as petrochemical producers cut their own costs because of lower feedstock prices.

"The precipitous drop in crude prices last week has really made the petrochemical users more conscious of a trend that has been happening for many months," notes Dexter Miller, a vice president at DeWitt & Co., a Houston-based consulting firm.

"If petrochemical producers could get a ride out of this [crude oil price drop], it would really help them right now. But they won't," adds Michael Horvath, senior consultant at Bonner & Moore Associates Inc., a consulting firm also based in Houston. Depending on the petrochemical, producers may enjoy only between a week to two months of improved profitability because of lower feedstock prices, Horvath tells C&EN.

Fluctuating feedstock costs are a big headache for petrochemical producers. When crude oil prices rise, petrochemical companies usually find it hard to raise prices of basic petrochemicals in proportion. The companies typically must give customers a month's notice of a price increase, and it often does not fly anyway, points out a source at a major chemical company.

However, the customers who resist price increases when feedstock prices rise usually are the same ones who demand immediate discounting off contract list prices when feedstock prices drop. "So the most profitable scenario is one with stable raw material prices," the source stresses.

Michael R. Krenek, vice president for chemicals at the Houston-based chemical consulting firm of Wright Killen & Co., notes, "When crude prices fell dramatically in 1986, petrochemical prices did not experience the same proportional decline that one would have expected. Critical variables were not conducive to such a phenomenon. For example, supply and demand were relatively balanced, demand for plastics was growing at a rapid rate, and exports were at high levels."

However, Krenek continues, now "these positive variables do not exist. In today's competitive environment it is more likely that decreases in feedstock costs will benefit consumers rather than petrochemical producers, as these reductions are reflected in lower end-product prices rather than in increased margins" for petrochemical producers.

U.S. makers of ethylene—a major petrochemical building block—may be hit particularly hard by the drop in crude oil prices. Seventy-five percent of all ethylene produced in the U.S. is based on natural gas liquids such as ethane, propane, or butane (only 25% is made from crude-oil-derived gas oil or naphtha). But end users of ethylene "are asking for price discounts in total disregard to what ethylene producers are using for feedstock," says Horvath.

While natural gas liquids prices are dropping "in sympathy" with crude oil prices, as is typical in energy markets, natural gas prices are not dropping as fast as crude prices, Horvath adds. Thus, profit margins at companies that make ethylene from natural gas liquids will drop faster than profits at firms that crack gas oil or naphtha.

Susan Ainsworth

Superconducting cable achieves high current

American Superconductor (ASC), Westborough, Mass., has produced a prototype, high-temperature superconducting conductor that exceeds the current-carrying threshhold required for commercial underground power transmission cables. ASC's partner in the project is Pirelli Cable of Milan, Italy.

The 1-meter-long conductor—based on a bismuth-strontium-calcium-copper oxide (BSCCO) superconductor (T_c = 110 K)—carries more than 2,300 amps of direct current at liquid nitrogen temperature (77 K), more than twice the typical 1,100 amps carried by conventional underground copper conductors. The Electric Power Research Institute, an industry-based R&D consortium that has funded development work at Pirelli, estimates that a current of 2,000 amps is desirable for cost-effective use of high-temperature superconducting cables in power transmission.

The ASC/Pirelli conductor competes with ones being developed by a Japanese company, Sumitomo Electric Industries, and by Intermagnetics General of Guiderland, N.Y. Gregory J. Yurek, ASC's president and chief executive officer, says that his firm now is "neck and neck" with Sumitomo, which is working with Tokyo utilities. "It's clearly been shown that the electrical performance of high-temperature superconductors is up to the task of achieving commercial needs," he says.

However, Carl H. Rosner, president of Intermagnetics—which develops high-temperature superconducting materials for use in power generation equipment as well as transmission cables—believes there will be greater market potential for superconducting cables that carry alternating, rather than direct, current.

ASC, founded in 1987, produces the superconducting wires used to make larger multistranded conductors by a widely used process called oxide powder-in-tube. In simple terms, a silver tube is packed with powdered precursor materials, drawn out into a wire,